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Could mainstream anti-smoking programs increase inequalities in tobacco use?

New Zealand data from 1981-96

S.E. Hill, T.A. Blakely, J.M. Fawcett and P. Howden-Chapman

*Department of Public Health, Wellington School of Medicine,
University of Otago, New Zealand*

Mainstream public health programs have the potential to improve average health outcomes at the expense of widening inequalities between different population groups.¹ From 1984 to 1990, the Government in New Zealand introduced one of the most comprehensive tobacco control programs in the world, including major increases in tobacco taxation, the introduction of smoke-free workplaces, and the prohibition of tobacco advertising.² In the 10 years from 1985, tobacco consumption in New Zealand fell more rapidly than for any other country in the OECD.³ While this decline was justly hailed as a public health success, little attention was paid to whether gains were shared evenly by all ethnic and socio-economic groups.

As with many other health risk factors, smoking (both in New Zealand and elsewhere) tends to be patterned by socio-economic position and ethnicity.⁴⁻⁷ Tobacco use is a significant risk factor for many of the most common causes of morbidity and mortality in developed countries, including ischaemic heart disease, cerebrovascular disease and several forms of cancer. Smoking may therefore be seen as one pathway that contributes to socio-economic and ethnic disparities in health. Modelling undertaken by the New Zealand Ministry of Health suggests that tobacco use accounts for one-third of the socio-economic mortality gradient and one-quarter of the ethnic gap in this country.⁸

In the past decade there has been an increasing emphasis on reducing inequalities in health.^{9,10} Public health is often characterised as promoting the dual goals of improving the health of the population as a whole, while decreasing health inequalities between population groups.¹¹ Despite this focus on reducing inequalities, there is a lack of research into the impact of state-led tobacco control programs on the distribution of smoking by socio-economic group or ethnicity.^{4,12} This omission prompted an international project under the European Commission looking at state-led tobacco control interventions alongside trends in smoking inequalities between different population groups.¹³ Our New Zealand-based study was undertaken in association with this wider project, offering an additional focus on ethnic inequalities in smoking.

This study describes the prevalence of smoking in different socio-economic and ethnic population groups within New Zealand, and examines how differences in smoking prevalence changed from 1981 to 1996. These descriptive data provide a basis for evaluating the impact of New Zealand's tobacco control program on socio-economic and ethnic differences in smoking and tobacco-related health outcomes.

Methods

We used cross-sectional data to analyse smoking prevalence according to income, education and ethnicity. Our primary source

Abstract

Objective: To examine changes in the socio-economic and ethnic distribution of smoking in the New Zealand population from 1981 to 1996, and to consider the implication of these data for policies aimed at reducing tobacco consumption.

Methods: Cross-sectional data were taken from 4.7 million respondents to the 1981 and 1996 New Zealand Censuses and 4,619 participants in a 1989 national survey, aged 15 to 79 years. Smoking prevalence rates were calculated by socio-economic position and ethnicity.

Results: Smoking prevalence fell in the period 1981-96 in every population group. However, socio-economic and ethnic differences in smoking increased in relative terms. Smoking prevalence ratios comparing the least advantaged with the most advantaged groups increased in men from 1.20 to 1.53 by income, 1.54 to 1.85 by education, and 1.49 to 1.67 by ethnicity. In women, prevalence ratios increased from 1.17 to 1.51 by income, 1.55 to 2.02 by education, and 1.85 to 2.20 by ethnicity. The greatest increase in socio-economic differences may have occurred during the 1980s, the period of greatest overall decline in total population smoking.

Conclusions: Socio-economic and ethnic disparities in New Zealanders' smoking patterns increased during the 1980s and '90s, a period of significant decline in overall smoking prevalence.

Implications: Public health programs aimed at reducing tobacco use should pay particular attention to disadvantaged, Indigenous and ethnic minority groups in order to avoid widening relative inequalities in smoking and smoking-related health outcomes.

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Correspondence to:

Dr T.A. Blakely, Department of Public Health, Wellington School of Medicine, University of Otago, PO Box 7343, Wellington, New Zealand. Fax: +64 4 389 5319; e-mail: tbladely@wnmeds.ac.nz

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was New Zealand Census data from 1981 and 1996. In both these years the Census included questions on cigarette smoking that allowed respondents to be grouped into three smoking categories: never-smokers (those who had never regularly smoked one or more cigarettes per day); ex-smokers (those who had previously smoked one or more cigarettes per day, but did not do so at the time of the Census); and current smokers (those who were smoking one or more cigarettes per day at the time of the Census). Supplementary data were obtained from the 1989 Life in New Zealand (LINZ) survey, a national survey comprising a randomised population sample drawn from the New Zealand electoral rolls (with snowball sampling for 15-to-18 year olds).¹⁴ Half of all LINZ survey participants were asked about their smoking habits, allowing them to be grouped into three smoking categories comparable with those derived from Census data.

The Census questionnaires included questions on respondents' income, educational qualifications and ethnicity. The LINZ survey included comparable questions on income, but it was not possible to derive educational or ethnic categories comparable with those used for Census data.

For both Census and LINZ data, income was categorised as total household income equivalised for the number of household members. (Equivalisation was achieved by dividing total household income by the square root of the number of household members.¹⁵) Respondents were divided into three income tertiles based on the distribution of household equivalised income within the total Census population.

Education was categorised into three groups according to highest-level qualification – i.e. those with post-school qualifications (including university, polytechnic and trade certificates); those with school-level qualifications; and those with no formal qualifications.

Respondents' ethnicity was defined as one of three prioritised groups: Maori, Pacific, and non-Maori non-Pacific. The non-Maori non-Pacific ethnic group is predominantly European (or *Pakeha*), and forms the largest of the three groups (comprising

87.8% of the study population in 1981 and 83.5% in 1996).

Analysis of smoking prevalence was limited to those Census and survey respondents aged 15 to 79 years. Prevalence rates by ethnic group were age-standardised by five-year age bands, and rates by income and education were both age- and ethnicity-standardised. Directly standardised prevalence rates and 95% confidence intervals were calculated according to the method given by Rothman and Greenland,¹⁵ using the 1996 Census population as the standard.

Results

In the 15-79 year age group, response rates for smoking questions were 98.2% in the 1981 Census and 92.2% in the 1996 Census; thus data were available on 2,195,724 individuals in 1981 and 2,483,727 individuals in 1996. The response rate for the LINZ survey (1989) was 70.9%, with smoking data available for 4,619 individuals in the 15-79 year age group.

Table 1 gives response rates and population distribution for household income, education and ethnicity among Census and survey respondents with smoking data.

Smoking by income

Smoking is clearly patterned by income, with the lowest smoking prevalence occurring in the highest income tertile and the highest prevalence in the lowest income group (see Figure 1). While smoking declined in every income group from 1981 to 1996, this decline was greatest in percentage terms in the highest income group, where there was a reduction in prevalence of 37% in men and 33% in women (see Table 2). Smoking fell least in the lowest income group, which experienced a 20% decline in men and a 14% decline in women. Consequently, the relative association between income and smoking strengthened from 1981 to 1996, as reflected by increasing prevalence ratios comparing lowest and highest income tertiles. Differences also increased in absolute terms, with a greater absolute decline in smoking

Table 1: Distribution (%) of Census and survey respondents by income, education and ethnicity.

	1981 (Census)		1989 (LINZ survey)		1996 (Census)	
	Men %	Women %	Men %	Women %	Men %	Women %
Income – household equivalised (tertiles)						
Highest	31.9	27.8	34.9	26.1	33.9	30.0
Intermediate	26.8	26.4	26.6	25.8	29.0	28.2
Lowest	17.8	24.0	24.7	32.1	19.7	24.9
Missing	23.5	21.8	13.8	16.1	17.4	16.8
Education – highest level qualification						
Post-school	27.1	18.2	–	–	42.0	32.7
School	14.6	15.5	–	–	24.0	30.7
None	49.3	55.2	–	–	33.3	35.8
Missing	8.9	11.2	–	–	0.7	0.8
Ethnicity						
Non-Maori non-Pacific	87.8	87.8	–	–	83.7	83.2
Maori	9.7	9.7	–	–	12.2	12.6
Pacific	2.5	2.4	–	–	4.1	4.2

prevalence among high-income compared with low-income groups.

There is a suggestion that the greatest increase in the income-smoking gradient may have occurred between 1981 and 1989 (see Figure 1), although the estimates for 1989 are statistically imprecise. Nevertheless, the gradient did increase for both males and females, and was 'smooth' in so much as the increases in smoking prevalence were similar from high- to medium- and medium- to high-income groups.

Smoking by education

As with income, smoking is strongly patterned by education, with the lowest prevalence rates in the group with post-school qualifications and the highest rates in those with no formal qualifications (see Table 3). From 1981 to 1996, smoking declined significantly in the highest-educated group, with falls of 31% in men and 26% in women. In contrast, the lowest-educated group experienced declines of 17% in men and only 4% in women.

The strength of the association between education level and smoking increased from 1981 to 1996 (see Table 3). In men, the ratio of smoking comparing the lowest and highest-educated groups rose from 1.54 to 1.85. In women, this ratio rose from 1.55 in 1981 to 2.02 in 1996. Thus, by 1996 the prevalence of smoking among women with no formal qualifications was twice as high as that in women with post-school qualifications.

Smoking by ethnicity

Smoking prevalence is strongly patterned by ethnicity, with Maori experiencing the highest rates, non-Maori non-Pacific the lowest rates, and Pacific peoples typically having a smoking rate intermediate between that of the Maori and non-Maori non-Pacific populations (see Table 4). The position of Pacific women in this smoking ladder changed between 1981 and 1996: in 1981, Pacific

women had the lowest smoking prevalence of any ethnic group, but by 1996 their smoking prevalence exceeded that of non-Maori non-Pacific women.

Smoking prevalence declined in every ethnic group from 1981 to 1996. The absolute decline in smoking prevalence was similar for Maori and non-Maori non-Pacific: 11.2 compared with 10.4 per 100 population for males, and 7.1 compared with 7.7 per 100 population for females. Given the higher baseline prevalence of smoking among Maori, however, the relative decline in smoking varied markedly by ethnicity. In non-Maori non-Pacific, smoking declined by 31% in men and 28% in women; among Maori the decline was 23% in men and 14% in women; and among Pacific peoples smoking fell by 18% in men and only 5% in women (see Table 4). Thus the association between ethnicity and in smoking prevalence strengthened between 1981 and 1996. By 1996, smoking in Maori women was more than two times the smoking rate for non-Maori non-Pacific women.

Discussion

We found evidence of clear socio-economic and ethnic differences in smoking within the New Zealand population, with the highest smoking prevalence seen in low-income, low-education groups and among Maori and Pacific peoples. While smoking prevalence fell from 1981 to 1996 in every population group, socio-economic and ethnic differences in smoking increased in relative terms. Comparing the least advantaged with the most advantaged groups, smoking prevalence ratios increased in men from 1.20 to 1.53 by income, 1.54 to 1.85 by education, and 1.49 to 1.67 by ethnicity. In women, prevalence ratios increased from 1.17 to 1.51 by income, 1.55 to 2.02 by education, and 1.85 to 2.20 by ethnicity. There was a suggestion that the greatest increase in the socio-economic gradient occurred in the 1980s, although

Figure 1: Smoking prevalence by income, 1981, 1989 and 1996.

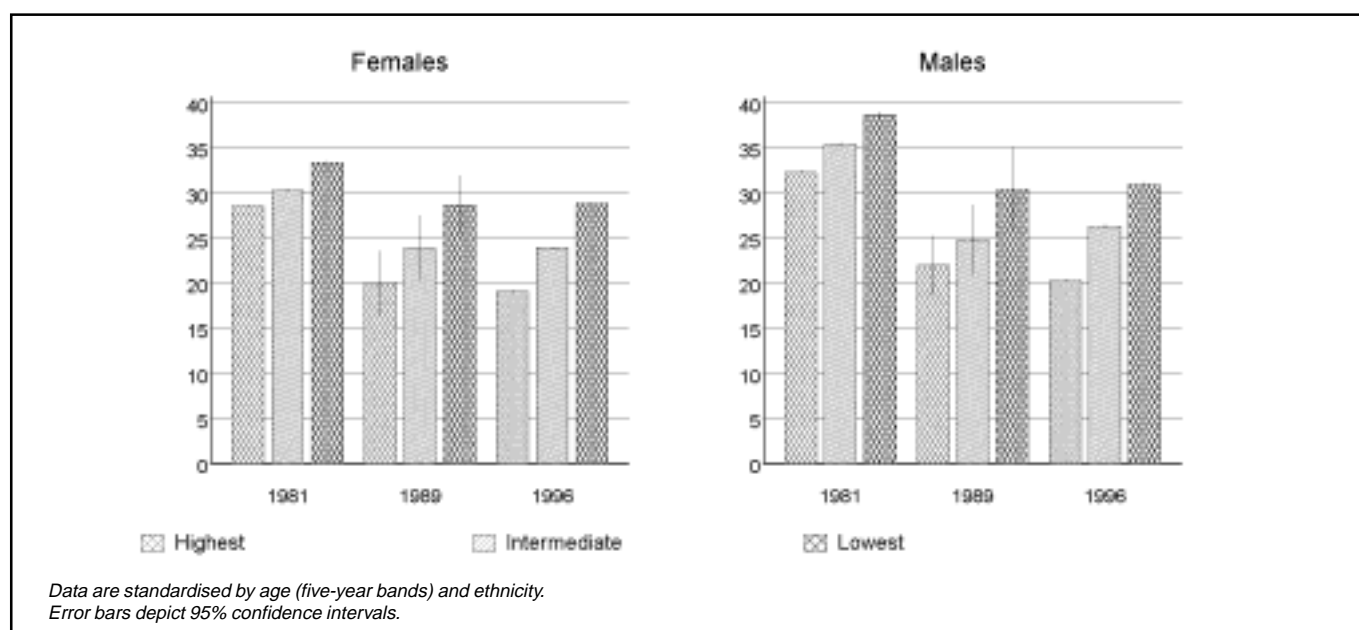


Table 2: Smoking prevalence, prevalence ratios and change in prevalence by income (household equivalised).

Income tertile	Smoking prevalence ^a (95% CI)	Prevalence ratio (95% CI)	Change in prevalence, 1981-96	
			Absolute	Relative
Men				
1981				
Highest	32.2 (32.0-32.4)	1		
Intermediate	35.3 (35.2-35.5)	1.10 (1.09-1.10)		
Lowest	38.6 (38.4-38.8)	1.20 (1.19-1.21)		
1989				
Highest	21.9 (18.6-25.2)	1		
Intermediate	24.7 (20.8-28.6)	1.13 (0.91-1.40)		
Lowest	30.3 (25.7-34.9)	1.38 (1.12-1.71)		
1996				
Highest	20.2 (20.1-20.3)	1.00	-12.0	-37%
Intermediate	26.3 (26.1-26.4)	1.30 (1.29-1.31)	-9.0	-25%
Lowest	30.9 (30.7-31.1)	1.53 (1.51-1.54)	-7.7	-20%
Women				
1981				
Highest	28.5 (28.3-28.6)	1		
Intermediate	30.2 (30.1-30.4)	1.06 (1.05-1.07)		
Lowest	33.3 (33.1-33.5)	1.17 (1.16-1.18)		
1989				
Highest	20.0 (16.5-23.5)	1		
Intermediate	23.8 (20.2-27.4)	1.19 (0.94-1.50)		
Lowest	28.6 (25.4-31.8)	1.43 (1.16-1.76)		
1996				
Highest	19.0 (18.9-19.1)	1	-9.5	-33%
Intermediate	23.9 (23.7- 24.0)	1.26 (1.25-1.27)	-6.3	-21%
Lowest	28.8 (28.6-28.9)	1.51 (1.50-1.53)	-4.5	-14%

Note:

(a) Smoking prevalence refers to the number of smokers per 100 population (i.e. the percentage of the population who smoke). Prevalence rates are standardised by five-year age group and ethnicity.

Table 3: Smoking prevalence, prevalence ratios and change in prevalence by education (highest-level qualification).

Highest qualification	Smoking prevalence ^a (95% CI)	Prevalence ratio (95% CI)	Change in prevalence, 1981-96	
			Absolute	Relative
Men				
1981				
Post-school	27.2 (27.0-27.4)	1.00		
School	33.5 (33.2-33.8)	1.23 (1.22-1.25)		
None	41.8 (41.6-41.9)	1.54 (1.52-1.55)		
1996				
Post-school	18.9 (18.7-19.0)	1.00	-8.3	-31%
School	25.0 (24.8-25.2)	1.33 (1.32-1.33)	-8.5	-25%
None	34.9 (34.7-35.0)	1.85 (1.84-1.86)	-6.9	-17%
Women				
1981				
Post-school	21.8 (21.6-22.1)	1.00		
School	26.5 (26.2-26.8)	1.21 (1.19-1.23)		
None	33.8 (33.7-33.9)	1.55 (1.53-1.57)		
1996				
Post-school	16.2 (16.0-16.3)	1.00	-5.6	-26%
School	21.5 (21.3-21.6)	1.33 (1.32-1.34)	-5.0	-19%
None	32.6 (32.4-32.8)	2.02 (2.01-2.03)	-2.3	-4%

Note:

(a) Smoking prevalence refers to the number of smokers per 100 population (i.e. the percentage of the population who smoke). Prevalence rates are standardised by five-year age group and ethnicity.

the statistical imprecision (relative to Census data) of the 1989 survey data must be kept in mind.

Our observations are based primarily on New Zealand Census data, which offer the advantages of a very high response rate (over 90%), substantial statistical power, and detailed information on socio-economic and ethnic groupings. A limitation of our analysis is the potential for selection bias, with significant changes in the population distribution by income and education from 1981 to 1996 (see Table 1). For education, the proportion of the population with no formal qualifications fell from over half in 1981 to around a third in 1996, with a corresponding increase in the proportion with school or tertiary qualifications. Thus the lowest educational category is likely to represent a more disadvantaged population group in the later period, which may exaggerate relative differences in smoking prevalence. This form of bias is less likely when considering income categories, which were divided into roughly equal tertiles for each Census population. However, the proportion of respondents with missing income and educational data was considerably higher in 1981 compared with 1996, so a selection effect cannot be ruled out.

Another limitation of this study is our inability to control for factors outside of government-led interventions to reduce tobacco consumption. Coincidental social and economic changes may confound the relationship between tobacco policy and population smoking rates. Thus we cannot positively attribute changing smoking patterns to the tobacco control program that existed at that time.

Notwithstanding the above limitations, our findings raise important questions about the role of tobacco control programs on socio-economic and ethnic differences in smoking. The period

from 1984 to 1990 was one of active state-led intervention, aimed explicitly at decreasing overall tobacco consumption (rather than reducing smoking inequalities between groups). This program was associated with a significant decline in New Zealand's overall smoking prevalence, which fell from 33% in 1983 to 27% in 1989.¹⁷ Our findings suggest that this fall was primarily driven by a decline in smoking among high socio-economic groups and the non-Maori non-Pacific population.

The role of tobacco taxation in the above changes is somewhat contentious. Increases in tobacco taxation are generally seen as one of the more effective levers for reducing tobacco consumption,^{2,3} and are often considered to be particularly effective for low-income groups.^{18,19} The latter premise is not supported by data presented here, which show that major increases in New Zealand's tobacco tax coincided with a period of increasing inequality in smoking by socio-economic position. It may be that the response to taxation is non-linear, with moderate price rises encouraging less-entrenched smokers to quit but leaving a 'core' of addicted smokers who respond less predictably to further price increases. New Zealand's tobacco taxation rose markedly during the 1980s and '90s, with the price of cigarettes effectively doubling between 1981 and 1994.² This compares with price increases in the order of 20% over 20 years in the studies cited above.^{18,19}

It should also be noted that the data presented here do not tell the full story. While differences in smoking *prevalence* widened during this period, we do not know how tobacco *consumption* may have changed within each socio-economic group. Smokers in low-income groups may have responded to price increases by reducing their tobacco consumption rather than giving up altogether. It may be that inequalities in smoking prevalence would

Table 4: Smoking prevalence, prevalence ratios and change in prevalence by ethnicity.

Ethnicity	Smoking prevalence ^a (95% CI)	Prevalence ratio (95% CI)	Change in prevalence, 1981-96	
			Absolute	Relative
Men				
1981				
Non-Maori non-Pacific	33.3 (33.2-33.4)	1.00		
Maori	49.5 (49.1-49.8)	1.49 (1.47-1.50)		
Pacific	42.2 (41.5-42.9)	1.27 (1.24-1.29)		
1996				
Non-Maori non-Pacific	22.9 (22.8-23.0)	1.00	-10.4	-31%
Maori	38.3 (38.0-38.5)	1.67 (1.66-1.68)	-11.2	-23%
Pacific	34.7 (34.2-35.1)	1.51 (1.49-1.53)	-7.5	-18%
Women				
1981				
Non-Maori non-Pacific	28.0 (27.9-28.0)	1.00		
Maori	51.7 (51.4-52.0)	1.85 (1.84-1.86)		
Pacific	24.4 (23.8-25.0)	0.87 (0.85-0.90)		
1996				
Non-Maori non-Pacific	20.3 (20.2-20.4)	1.00	-7.7	-28%
Maori	44.6 (44.3-44.8)	2.20 (2.18-2.21)	-7.1	-14%
Pacific	23.2 (22.8-23.6)	1.14 (1.12-1.16)	-1.2	-5%

Note:

(a) Smoking prevalence refers to the number of smokers per 100 population (i.e. the percentage of the population who smoke). Prevalence rates are standardised by five-year age group.

have been even worse in 1996 if methods other than tobacco taxation had been used to bring down smoking rates. The impact of tobacco taxation on smoking inequalities may depend in part on what other smoking reduction interventions are in place, as well as contemporary economic and social policies. In New Zealand, fully subsidised nicotine replacement therapy was not available until the late 1990s; prior to this, low-income smokers are likely to have experienced greater financial barriers to smoking cessation.

Other authors have suggested that mainstream public health interventions have the potential to increase inequalities in health, at least in the short term.¹ It may be that health promotion messages have their greatest initial impact on those with higher educational achievement and better access to material resources.²⁰ Such groups are also less likely to be affected by financial barriers to primary health care and other vehicles of health education.²¹ Other interventions may also be more successful in reaching advantaged population groups. For example, the introduction of smoke-free workplaces in the 1990s appears to have been more effective for those in white-collar occupations and for non-Maori non-Pacific workers.^{22,23}

In conclusion, we found evidence of increasing relative inequalities in smoking within the New Zealand population during a period of comprehensive tobacco control and declining total smoking prevalence. This raises the possibility that mainstream anti-smoking interventions may have contributed to a decline in overall tobacco use at the expense of increasing inequalities in smoking. These findings highlight the need to pay particular attention to disadvantaged, Indigenous and ethnic minority groups in any public health program. Programs should include efforts to enhance access to health interventions for low-income groups, and to remove cultural and social barriers experienced by disadvantaged population groups. Such an approach will help achieve the dual public health goals of lower overall smoking and reduced inequalities in smoking and smoking-related health outcomes.

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